



# **North Carolina Area-Wide Optimization Program 2020 Annual Report**

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NC Division of Water Resources  
Public Water Supply Section

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## **NC Area Wide Optimization Program 2020 Annual Report**

### **Maintaining the Program**

The North Carolina Department of Environmental Quality (NC DEQ), Public Water Supply (PWS) Section has participated in the EPA Region 4 Multi-State Area Wide Optimization Program (AWOP) since 2000. The program's goal is to provide North Carolina's water utilities with needed training and tools that can assist in maximizing the water system operations, thus improving public health.

Data from all surface water treatment facilities is evaluated annually to maintain a status component. Data evaluated includes turbidity, microbial, and disinfection byproduct (DBP) performance information. In 2020, 148 surface water plants operated during the year. The following is a summary report of the 2020 NC AWOP findings and activities.

While North Carolina's AWOP team continues to engage in a number of beneficial activities that support the maintenance of its AWOP, the team also faces challenges.

#### Institutional Barriers

The NC AWOP is a volunteer effort for participating systems and the PWS Section's staff. Time dedicated to the implementation of the NC AWOP is limited because of attention to regulatory requirements and other PWS Section activities. While compliance with drinking water regulations is our primary goal, the NC AWOP Team recognizes and operates with the understanding that optimization provides an additional level of public health protection and strives to meet the program goals.

#### Internal Support

Program support remains high on both the Division and Section levels. Prior to the Covid19 pandemic, our staff was not restricted from traveling to meetings or from conducting optimization activities in the state. During the pandemic, staff have continued to remotely participate in NC AWOP Team quarterly meetings and EPA Region 4 AWOP planning meetings/workshops using video conferencing software. Funding has also been made available in the past for purchasing equipment used to grow the program.

The Drinking Water State Revolving Fund (DWSRF) set-asides are the primary source of funding for the NC AWOP. Continued demonstration of the benefits of the NC AWOP will allow for future staff recruitment to ensure program maintenance and/or enable growth.

#### Core Team Structure and Capacity

In 2020, the NC AWOP Team consisted of twelve staff participants from the PWS Section who worked to sustain the program by participating in varying activities, such as evaluating system capabilities and providing technical training to systems (Table 1).

Four members functioned as the core team and are responsible for ensuring the program's continued viability. The other members are in different stages of certification, technical knowledge, experience, and understanding of the AWOP philosophies, and provide expertise as opportunities present themselves.

**Table 1**

| <b>PWSS Staff</b>                    | <b>Program Activity</b>   | <b>AWOP Certified</b>      |
|--------------------------------------|---|----------------------------|
| Eric Hudson                          | Core Team Member<br>Program Manager   | Yes                        |
| Rebecca Sadosky                      | Core Team Member<br>CPE Technical Support<br>Central Office Technical Advisor | Yes                        |
| Mark Hahn                            | Core Team Member<br>Regional Technical Advisor                                | Yes                        |
| Kimberly Barnett                     | Core Team Member<br>Regional Technical Advisor                                | No (2 DS CPE)              |
| Clif Whitfield                       | Regional Technical Advisor  | No (2 DS CPE, 1 DBP PBT)   |
| Brad Whitman                         | Central Office Technical Advisor  | No (1 DS CPE)              |
| Turner Morrison                      | Central Office Technical Advisor  | No (2 DS CPE)              |
| Tommy Overby                         | Regional Technical Advisor  | No                         |
| Lauren Plummer<br>-left team 11/2020 | Central Office Technical Advisor  | No                         |
| Meredith Guglielmi                   | Regional Technical Advisor  | No (1 Microbial, 1 DS CPE) |
| Emily Lester                         | Central Office Technical Advisor  | No (1 Microbial CPE)       |
| Nicole Hairston                      | Regional Technical Advisor  | No                         |

DS – Distribution System

DBP – Disinfection Byproducts

PBT – Performance Based Training

CPE – Comprehensive Performance Evaluation

#### Program Assessment

NC AWOP activities included: participation in the EPA Region 4 meetings, NC AWOP Team quarterly meetings, evaluation of system data, and training events throughout the year. These activities along with previous DBP performance based trainings (PBTs) and microbial and DBP comprehensive performance evaluations (CPEs) have served as valuable training opportunities and have allowed key NC AWOP members to obtain their AWOP certification, while aiding others in their progress towards certification. The NC AWOP is currently a strong and knowledgeable workgroup comprised of both seasoned veterans as well as up-and-coming staff.

In 2020, the NC AWOP Team used video conferencing software to introduce a Total Organic Carbon (TOC) and DBP Tracking Tool to regional office supervisors. The tool generates graphs of TOC removal efficiency at a water treatment plant versus DBP concentrations in the distribution system. These graphs are used to explain the relationship of TOC removal and the impact on DBP levels to water treatment plant staff and management.

The AWOP Team also hosted a knowledge sharing session for PWS Section staff to introduce a reference guide, created by the team, on the Concentration x Time (CT) Method for evaluating inactivation of *Giardia lamblia* cysts and viruses based on water treatment plant operational data and disinfection conditions. The document was created to provide a foundation for staff to understand CT methodology and promote consistency when reviewing water treatment plant CT calculations.

## **Plant Status and Rankings for Microbial Contaminants and DBPs**

### **Microbial Status and Ranking Component**

The PWS Section has maintained a plant status and ranking component since 2001 for microbial contaminants. The microbial and turbidity plant ranking methodology was revised in 2014 to better reflect which systems receive more violations and have higher finished water turbidities (see APPENDIX B). Emphasis was placed on these two parameters because they most directly affect public health and, therefore, are of the greatest concern. To calculate the ranking scores, the average monthly finished water turbidity for a system is multiplied by 100, while the average settled turbidity is multiplied by 3.16, giving the finished water turbidity more weight than the settled water turbidity in the revised ranking scores. The lower the water plant's ranking score, the better their performance on turbidity and microbial indicators. Typically, water plants meeting AWOP finished water turbidity goals year-round have a ranking score of 200 or below.

### **Prioritized List of Facilities - Microbial**

The NC AWOP Microbial/Turbidity Ranking Score is used to identify and prioritize surface water facilities for technical assistance in optimizing microbial performance. The calculated ranking scores for the facilities with the highest 15 (top 10 percent) microbial/turbidity rankings for 2020 are presented in Table 2 along with the system's 2019 ranking score.

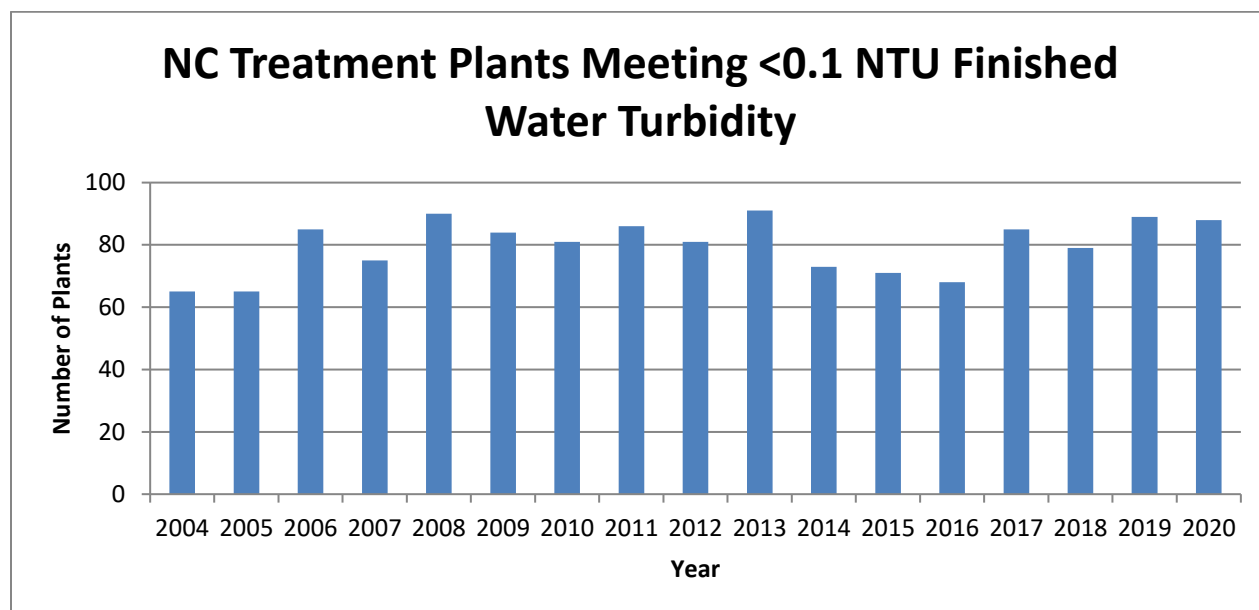
**Table 2**

| <b>2020 Rank</b> | <b>System Name</b>   | <b>2019 Rank</b> |
|------------------|--|------------------|
| 1                | Anson County Water System<br>(Anson County WTP)              | 1                |
| 2                | City of Rocky Mount<br>(Tar River Reservoir WTP)             | 14               |
| 3                | Town of Canton<br>(Penland WTP)                              | 66               |
| 4                | Town of Yanceyville<br>(Yanceyville WTP)                     | 2                |
| 5                | Town of North Wilkesboro<br>(North Wilkesboro WTP)           | 11               |
| 6                | Town of Mount Pleasant<br>(Mt. Pleasant WTP)                 | 10               |
| 7                | Town of Ramseur<br>(Ramseur WTP)                             | 9                |
| 8                | Town of Denton<br>(Denton WTP)                               | 22               |
| 9                | City of King<br>(King WTP)                                   | 18               |
| 10               | Enfield Water System<br>(Enfield WTP)                        | 16               |
| 11               | Davie County Water System<br>(Cooleemee WTP)                 | 17               |
| 12               | City of Winston-Salem<br>(Neilson WTP)                       | 19               |
| 13               | Pilgrim's Pride Water System<br>(Pilgrim's WTP)              | 15               |
| 14               | South Granville Water and Sewer<br>Authority<br>(Butner WTP) | 21               |
| 15               | Town of Beech Mountain<br>(Beech Mountain WTP)               | 8                |

The Town of Canton's ranking changed from 66 in 2019 to 3 in 2020. The primary reason for this change is because the water system received a treatment technique violation in 2020 for failing to maintain a 1.0 CT ratio for a single day.

### Average Finished Water Turbidity

The number of facilities that averaged <0.10 NTU finished water turbidity in each year from 2004 to 2020 is presented in Figure 1. The number of plants meeting this goal has fluctuated from a low of 65 plants in 2004 to a high of 91 plants in 2013. In 2020, 88 plants met the goal.



**Figure 1**

### DBP Status and Ranking Component

The DBP status and ranking component, initiated in 2006, is based on compliance data and identifies the systems where maximum contaminant levels (MCLs) are being exceeded. The DBP status component is a focused tool that was used by the PWS Section to provide technical assistance to systems struggling to comply with the Stage 1 Disinfectants and DBPs Rule. In 2013, the PWS Section adopted more stringent DBP goals, which focus on locational running annual averages (LRAAs) introduced in the Stage 2 Disinfectants and Disinfection Byproducts Rule. Achieving these more stringent DBP goals indicates better water quality throughout the distribution system. The adopted DBP goals are used as a benchmark for evaluating water system performance and for identifying opportunities to provide technical assistance.

### Prioritized List of Systems - DBPs

Maintaining compliance with disinfection byproduct regulations presents a significant challenge to water systems in North Carolina. The NC AWOP bases its prioritization for DBPs on LRAAs of total trihalomethanes (TTHMs) and 5 haloacetic acids (HAA5s), which is consistent with Stage 2 Disinfectant and DBP Rule requirements. Figures 2 and 3 below display the ten highest HAA5 and TTHM LRAAs from 2020 for surface water systems. One system had one sampling site exceed the HAA5 MCL (0.06 mg/L)

based on the LRAA. Similarly, one system had one sampling site exceed the TTHM MCL (0.08 mg/L).

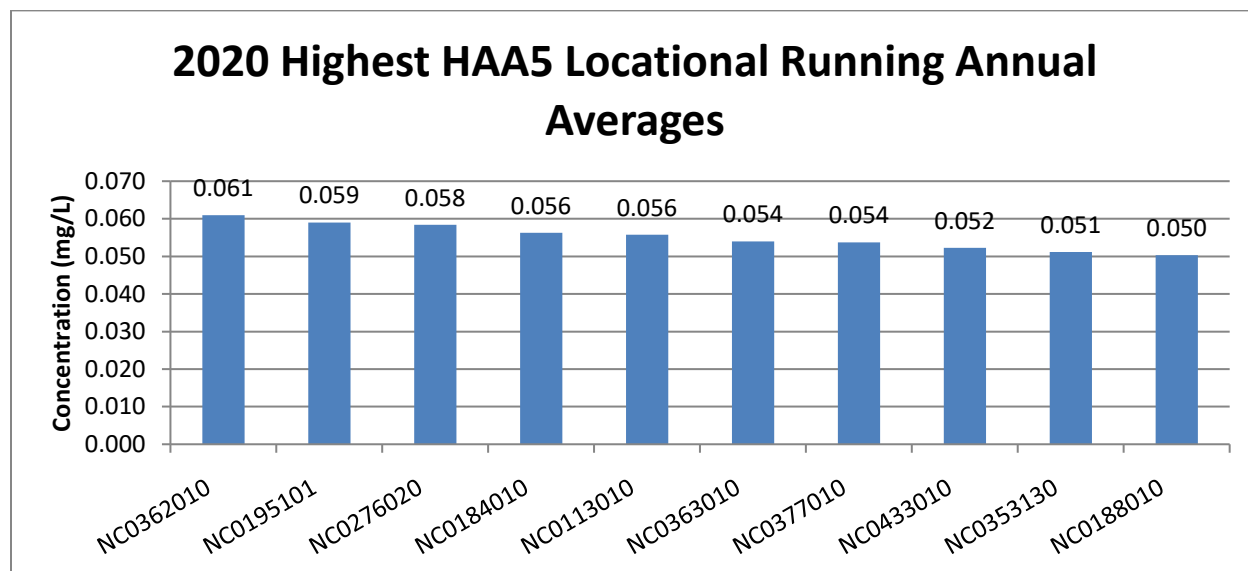


Figure 2

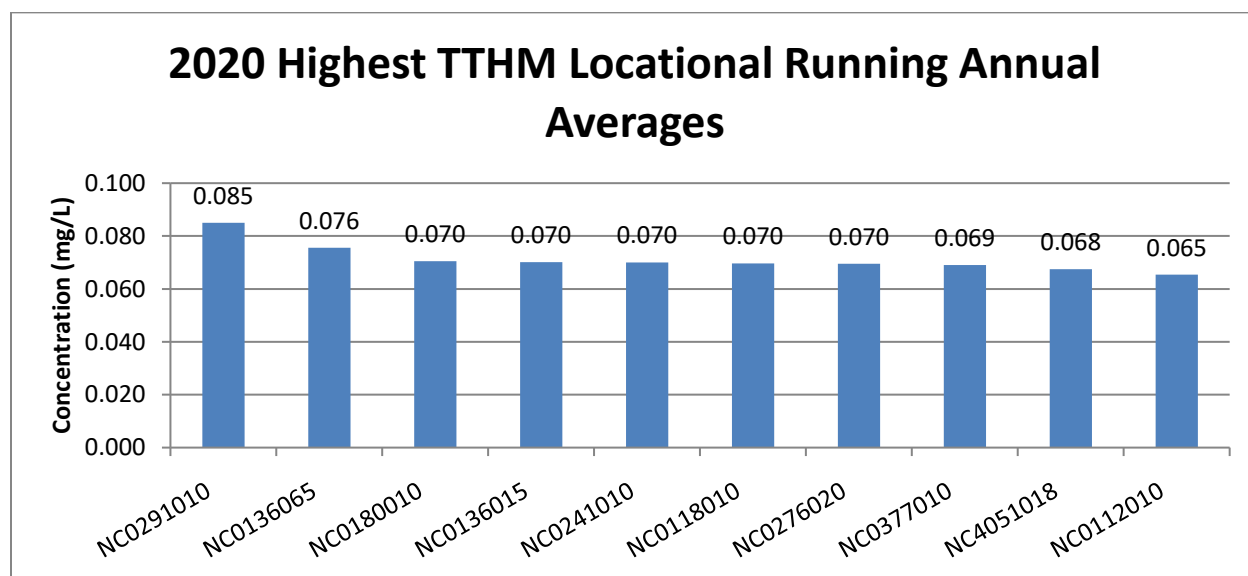
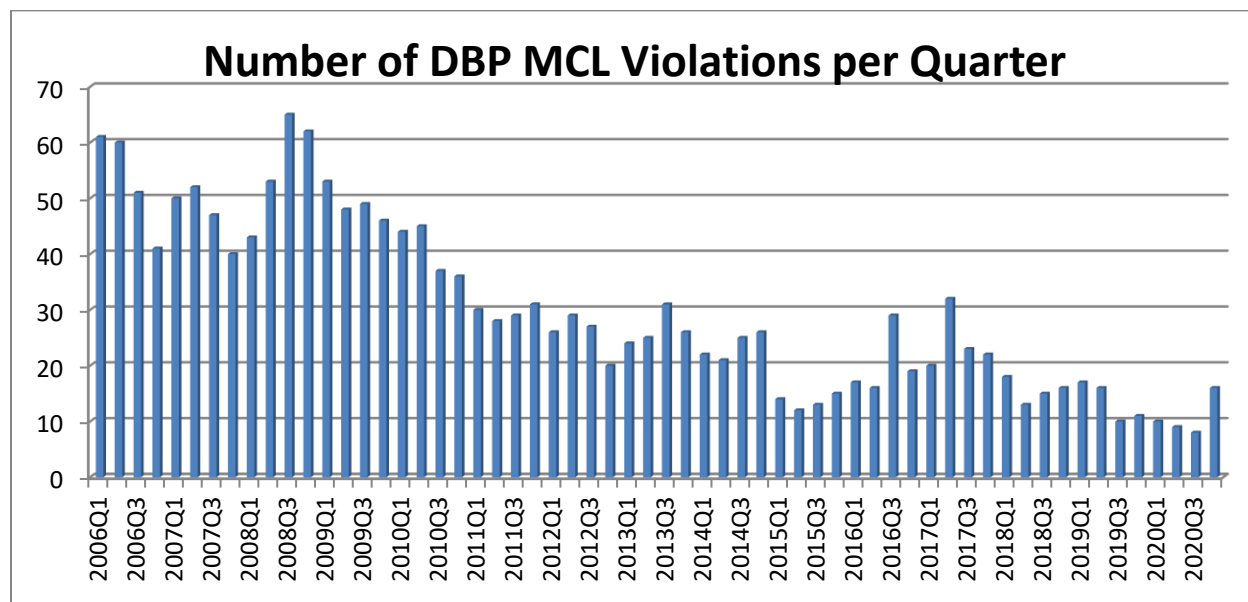


Figure 3

Figure 4 below displays the number of DBP MCL violations that have been issued to all water systems (surface water, surface water purchase, groundwater and groundwater purchase) since 2006. TTHM MCL violations account for approximately 65% of the total and HAA5 MCL violations accounting for approximately 35% of the total.



**Figure 4**

DBP concentration data was evaluated for surface water and surface water purchase systems required to sample for DBPs. In 2020, 93 out of 127 (73%) surface water systems, serving a population of 4,671,687 customers, and 313 out of 329 (95%) surface water purchase systems, serving a population of 1,275,627 customers, met the NC DBP distribution system goals (provided in APPENDIX A).

### **Targeted Performance Indicator (TPI) Implementation**

#### Running List of Activities

The NC AWOP Team activities include participation in EPA Region 4 quarterly meetings, assimilating/evaluating system data and training/evaluation events. The following is a list of North Carolina activities for 2020 (Table 3).



**Table 3**

| <b>Date - 2020</b> | <b>Activity</b>  | <b>Attendee(s)</b>  |
|--------------------|--|---|
| Jan. 8             | NC AWOP Team Meeting at WSRO   | NC AWOP Team  |
| Mar. 10-12         | Region 4 AWOP Planning Meeting<br>– Winston-Salem, NC  | Eric Hudson<br>Turner Morrison<br>Rebecca Sadosky<br>Brad Whitman<br>Bob Midgette |
| July 15            | NC AWOP Team Meeting<br>– remote meeting via Microsoft Teams   | NC AWOP Team  |
| Aug. 11-13         | Region 4 AWOP Planning Meeting<br>– remote meeting via Microsoft Teams   | Eric Hudson<br>Kimberly Barnett<br>Rebecca Sadosky                                |
| Sept. 9            | Hosted a knowledge sharing session for<br>Regional Office supervisors to introduce the<br>TOC and DBP Tracking Tool<br>-remote meeting via Microsoft Teams                     | Turner Morrison<br>Katie Richardson   |
| Oct. 7             | NC AWOP Team Meeting<br>– remote meeting via Microsoft Teams   | NC AWOP Team  |
| Nov. 12            | Hosted a knowledge sharing session for PWS<br>Section staff to introduce a NC AWOP<br>reference guide on CT Disinfection<br>Methodology<br>-remote meeting via Microsoft Teams | Brad Whitman<br>Lauren Plummer<br>Meredith Guglielmi<br>Mark Hahn<br>Eric Hudson  |
| Nov. 17-19         | Region 4 AWOP Planning Meeting<br>- remote meeting via Microsoft Teams   | Eric Hudson<br>Kimberly Barnett   |
| Dec. 1             | Presentation on CT Disinfection Methodology<br>to a NC Waterworks Operator Association<br>section meeting<br>-remote meeting via Microsoft Teams                               | Eric Hudson   |
| Oct. – Dec.        | AWOP Team members presented AWOP<br>Turbidity Optimization Awards to water<br>systems and their governing bodies if so<br>requested.   | NC AWOP Team  |

**Site Selection Process**

Facilities are selected for CPEs and PBTs based on their priority rankings (microbial and DBP), their regional proximity, and by request. It is important that NC AWOP efforts are evenly distributed throughout the state. This approach allows for a more diverse program that still serves the most in-need facilities.

### Covid19 Pandemic

Travel restrictions due to the Covid19 pandemic prohibited staff from conducting on-site optimization activities in 2020. Staff did not conduct special studies at water plants nor participate in multi-state CPEs like previous years.

### Building Awareness & Recognition

Participation in the NC Waterworks Operator Association and NC American Water Works Association and Water Environment Association activities has been instrumental in introducing AWOP tools and concepts into routine operator training. In conjunction with the NC AWOP events, these activities have been instrumental in the overall improvement in North Carolina's facilities.

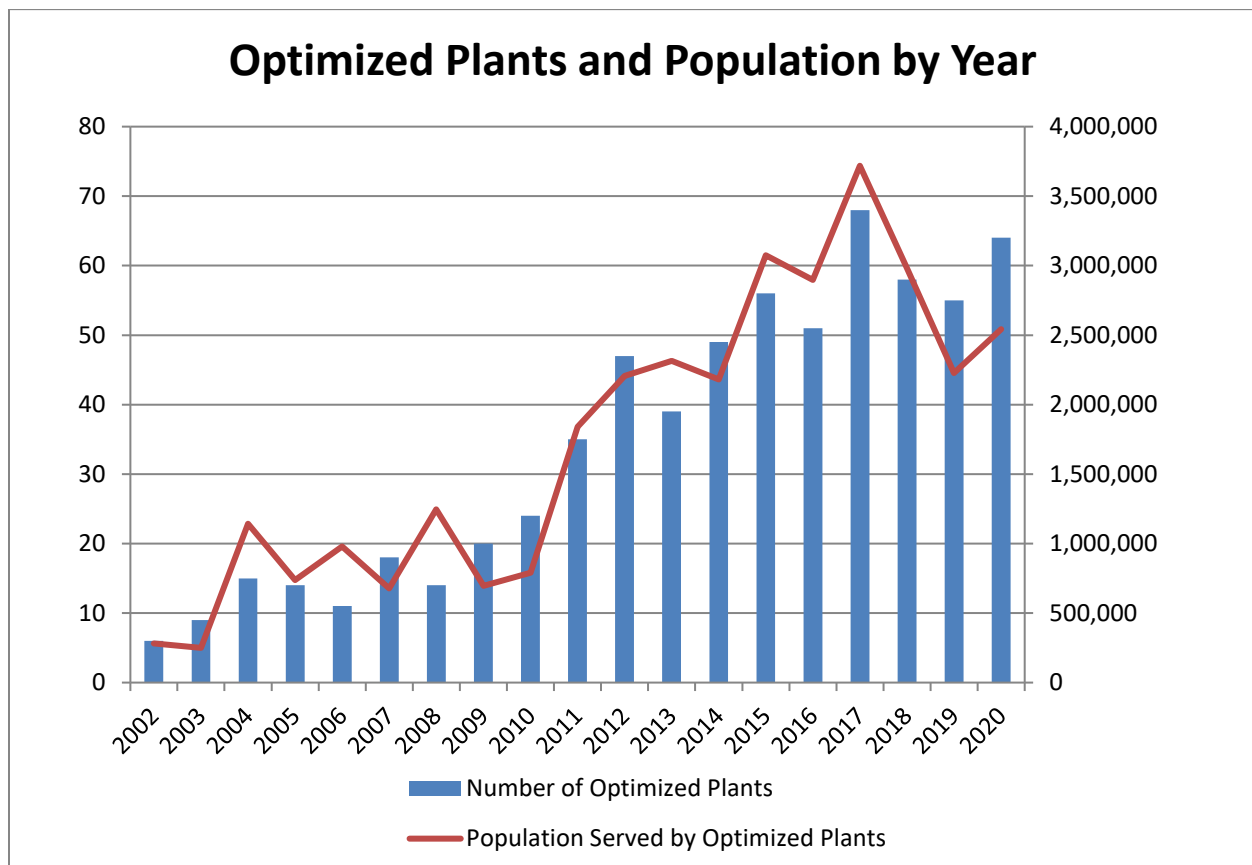
Additional effort to facilitate and educate North Carolina's water system operators about the benefits of the AWOP has led to the production of NC AWOP flyers and posters. These flyers contain basic information about the program along with the AWOP goals. The flyers have been provided to water treatment facility staff and discussed during routine inspections. NC AWOP Team members distributed water resistant AWOP posters to each surface water plant. More work is needed to develop innovative approaches that will reach additional facilities and provide the necessary technical assistance to achieve their goals.

The PWS Section issues annual certificates to facilities that meet the NC AWOP microbial optimization goals for settled and finished water turbidity. The awards reflect the number of years that a plant has achieved optimized status and also includes special recognition for plants that have received the award for 10 or more consecutive years.

The PWS Section also issues a press release listing the facilities that received the annual certificates. In many communities the achievement of the AWOP goals and certificate award has been reported by the local media. DEQ has also posted pictures of the award presentations on Facebook and Twitter.

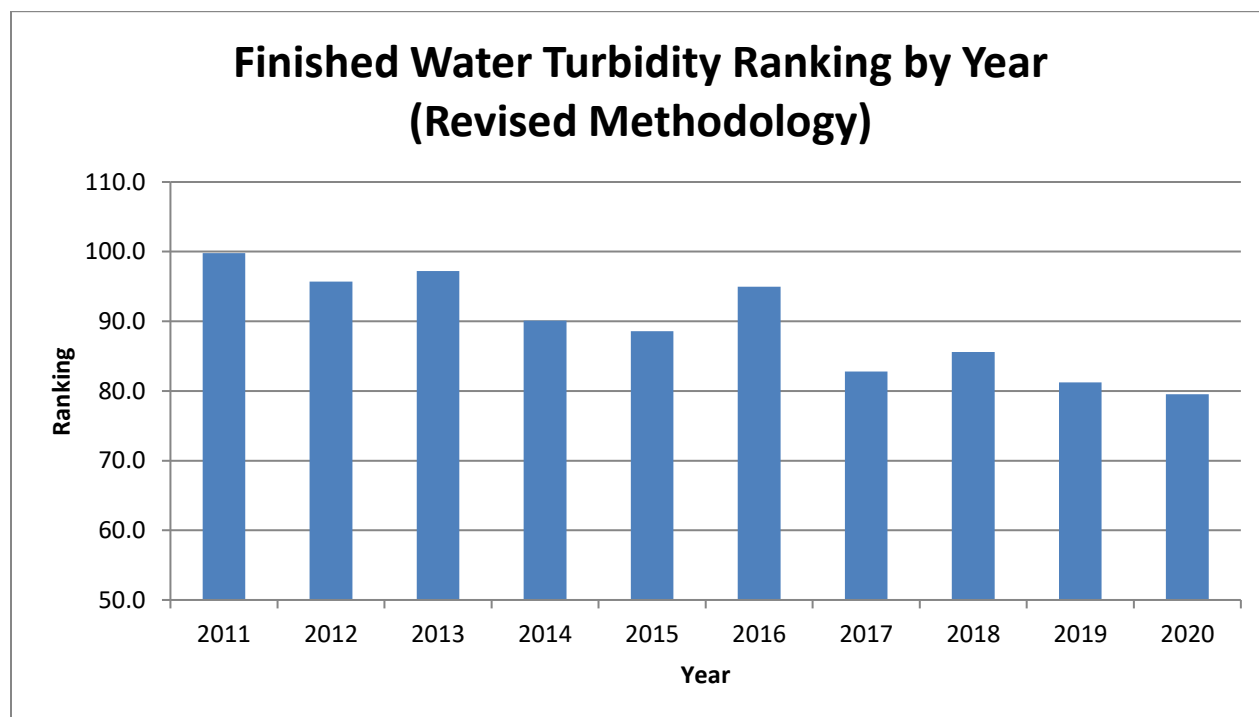
## AWOP Impacts

The total number of systems that met the optimization goals for finished and settled water turbidity since 2002 and the population serviced by these systems are presented in Figure 5. In general, there has been an increase in the number of optimized plants and in the population served. In 2019, there were 55 optimized water treatment plants that served a population of 2,227,355. In 2020, there were 64 optimized water treatment plants that served a population of 2,543,059. This represents a 14% increase in population from 2019. The primary reasons for the change in the number of optimized plants may be attributed to water plant treatment procedure changes, construction project impacts, or weather events.



**Figure 5**

Figure 6 shows the decreasing average finished water turbidity which demonstrates the continued improvements made by surface water facilities in North Carolina.



**Figure 6**

### **Lessons Learned**

Participating water system management and staff have learned that notable change in performance will take both time and consistent effort. Significant improvement requires a concerted data collection effort, application of available tools, and diligent individuals who are willing to explore new approaches to old processes. System management must be willing to allow the needed changes to be made as well as maintain adequate operational staff to accommodate data collection and evaluation. Basic understanding of AWOP concepts and approaches helps water operators and management make informed decisions to accomplish improvements in plant and system operations.

The experience, skills, and knowledge gained with the participation in the AWOP benefit both water system and state staff. It provides both insight into the functional aspects of water treatment as well as improved knowledge, skills, and abilities that allow staff to make more informed evaluations and provide valuable technical assistance, which further contributes to protecting public health in North Carolina.

Effort is needed by the NC AWOP Team members familiar with local facilities and the AWOP to maintain and increase the participation of all surface water facilities. Development of innovative training approaches and partnerships would promote the program and ultimately benefit additional systems.

Participating in a multi-state CPE is a great way to get AWOP experience. In addition, it facilitates discussion with colleagues to share experiences on improving water treatment and water quality.

Conducting special studies provides training opportunities for staff to gain experience using AWOP tools and allows the NC AWOP Team to provide technical assistance to participating water systems.

Providing a professional printed and framed AWOP award instills pride and may motivate surrounding water systems to seek the award. Posting pictures of award presentations on agency social media is a great way to build awareness and provides positive publicity that is important to many water systems.

## APPENDIX A

## North Carolina's Optimization Goals

| Category            | Goal   | Description   |
|---------------------|--|---|
| Microbial           | Minimum Data Monitoring Requirement              | <ul style="list-style-type: none"> <li>▪ Daily raw water turbidity.</li> <li>▪ Settled water turbidity from sedimentation basins at four-hour increments.</li> <li>▪ On-line, continuous turbidity from each filter.</li> </ul>   |
| Microbial           | Individual Sedimentation Basin Performance Goals | <ul style="list-style-type: none"> <li>▪ Settled water turbidity &lt; 2 NTU in 95% of readings when the annual average raw turbidity is &gt; 10 NTU.</li> <li>▪ Settled water turbidity &lt; 1 NTU in 95% of readings when the annual average raw turbidity is ≤ 10 NTU.</li> </ul>   |
| Microbial           | Individual and Combined Filter Performance Goals | <ul style="list-style-type: none"> <li>▪ Filtered water turbidity of less than 0.10 NTU in 95 percent of the maximum turbidity samples recorded each day (excluding 15-minute period following filter backwash).</li> <li>▪ Maximum individual filtered water turbidity of 0.3 NTU.</li> <li>▪ Filter backwash initiated before effluent turbidity exceeds 0.1 NTU.</li> <li>▪ Filter to waste until turbidity is less than 0.1 NTU.</li> <li>▪ Maximum filtered water measurement of less than 10 particles (in the &gt; 2 micron range) per milliliter (if particle counters are available).</li> </ul> |
| Distribution System | Disinfection Byproducts Performance Goals        | <ul style="list-style-type: none"> <li>▪ Individual Site Goal: Quarterly Maximum Locational Running Annual Average TTHM/HAA5 values not to exceed 70/50 ppb.</li> <li>▪ Long-Term System Goal: Average of Maximum Locational Running Annual Average TTHM/HAA5 values not to exceed 60/40 ppb (the average of the last 8 quarters cannot exceed 60/40 ppb).</li> </ul>   |

## APPENDIX B



## NC AWOP Microbial/Turbidity Ranking Score Calculation

$$\begin{aligned} &1000 * \text{Total Number of Tier 1 Acute MCL Violations per Year (Fecal)} \\ &+ \\ &750 * \text{Total Number of Tier 2 MCL Violations per Year (TC / Turb.)} \\ &+ \\ &500 * \text{Total Number of Tier 3 Monitoring and Treatment Technique Violations per Year (CT /} \\ &\text{Turb.)} \\ &+ \\ &100 * \text{Average Monthly Finished Water Turbidity} \\ &+ \\ &10 * \text{Max Monthly Finished Water Turbidity} \\ &+ \\ &3.16 * \text{Average Monthly Settled Water Turbidity} \\ &+ \\ &0.316 * \text{Max Monthly Settled Water Turbidity} \\ &+ \\ &0.1 * \text{Average Monthly Raw Water Turbidity} \\ &+ \\ &0.01 * \text{Max Monthly Raw Water Turbidity} \\ &= \\ &\underline{\text{Total Ranking Score}} \end{aligned}$$

\*\*Note that raw water coliform is only considered in the rankings if two systems have the same score using the calculation above. The raw water coliform will be used as a “tiebreaker” in this case.\*\*